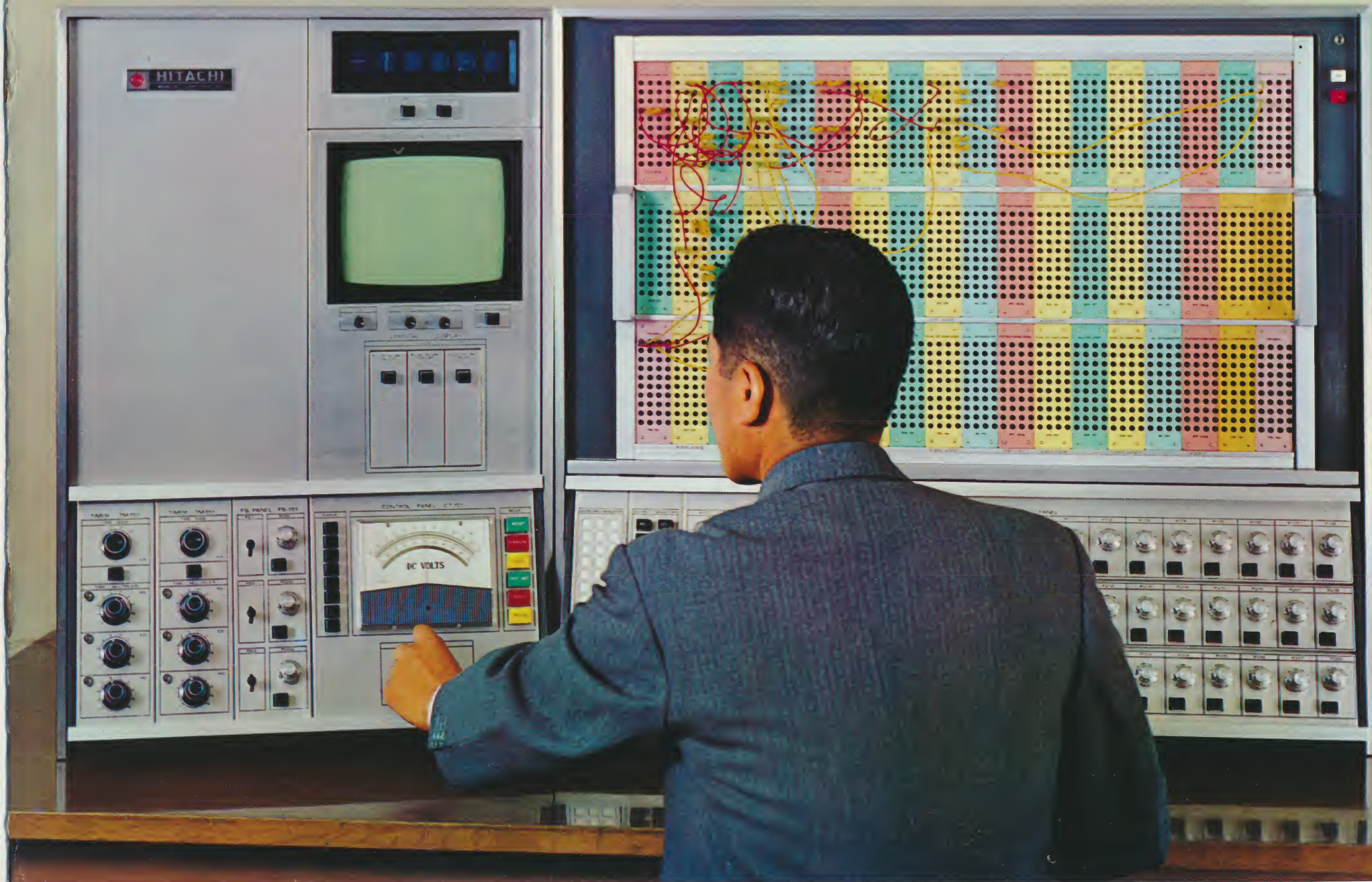


HITACHI 505 *analog computer*



INTRODUCTION

The Hitachi 505 introduces to the computer user the efficiency of a completely new, low cost, advanced analog computer built to the highest quality standards. The 505 provides a number of new features through state-of-the-art design techniques and components in addition to operational capabilities normally found only on high cost, big computers. A new level of computing efficiency is made possible through the use of "operator convenience engineering"; in the design of the main computer particular attention was given to the operating console portion.

Routine simulations as well as complex and difficult computations requiring high speeds, unique function generation capabilities and precision can be solved on the 505 by the engineer, researcher or scientist.



HITACHI 505 ANALOG COMPUTER

The computer basically consists of solid-state D.C. amplifiers provided with FET chopper circuits. These amplifiers have a 100 volt 20 ma output with low drift and high S/N ratio for high accuracy.

Iterative computations are facilitated by special Compiled Operation Modules containing networks used in automatic parameter changing, boundary value problems and other functions necessary in iterative operations.

Flexible selection of integrator gains, from 1 to 1,000, and the ratio between real time and time in the high speed repetitive mode of 1 to 0.001 permits easy operator control for computing and readout speed.

A logic control panel furnishes digital logic components for use with analog computing elements for the solution of intricate iterative and logical computations.

The computer panel assembly has provisions for 54 modules including 40 operational amplifiers and 19 non-linear and dual integrator modules. A wide selection of interchangeable modular non-linear computing components is available.

Readout of solutions is obtained with a 4 digit DVM or a 3 channel 9" oscilloscope. The solutions are also available externally for a X-Y plotter or other monitoring devices.

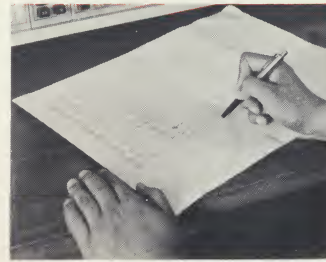
The Hitachi 505 furnishes a number of functions that permit efficiency and flexibility over a wide range of applications.

A three-channel 9" oscilloscope provides a continuous display of solutions, and is arranged so that three solutions may be observed simultaneously. Electronically generated scales are displayed on the tube face and provide an accurate reference during readout of solutions.

A large selection of function generators is available for special purposes, including: 3 different fixed breakpoint function generators; 1 variable breakpoint function generator; 2 trigonometric function generators; 2 log function generators; 2×2 function generators; and a new two-variable function generator. The two-variable function generator, in particular, is a novel silicon transistor device featuring 25 non-interacting fixed breakpoints.

The completely shielded, color coded patchboard has been designed with the programmer in mind. Most connections may be made with low capacity bottle plugs. Also, a unique method for temporary labeling of the potentiometers is provided.

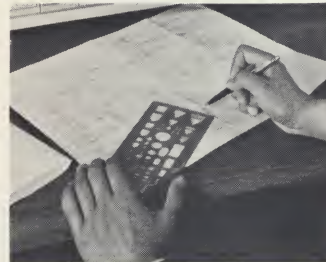
FIVE STEPS IN ANALYSIS OF PROBLEMS USING THE HITACHI 505



1

Statement of the problem

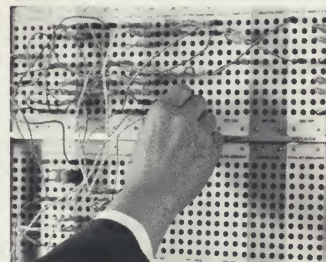
The problem to be analyzed should be expressed as a system of differential equations.



2

Programming

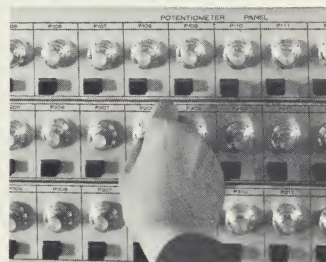
A block diagram representing these mathematical formulas on the computer may be obtained by the interconnection of computer modules.



3

Patching

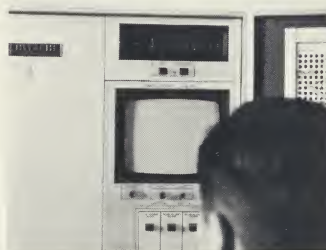
Hitachi 505 computer modules located in the patchpanel are interconnected by patch cords to simulate a given problem.



4

Coefficient set up

The desired parameters are set up by means of the corresponding potentiometers.



5

Solution

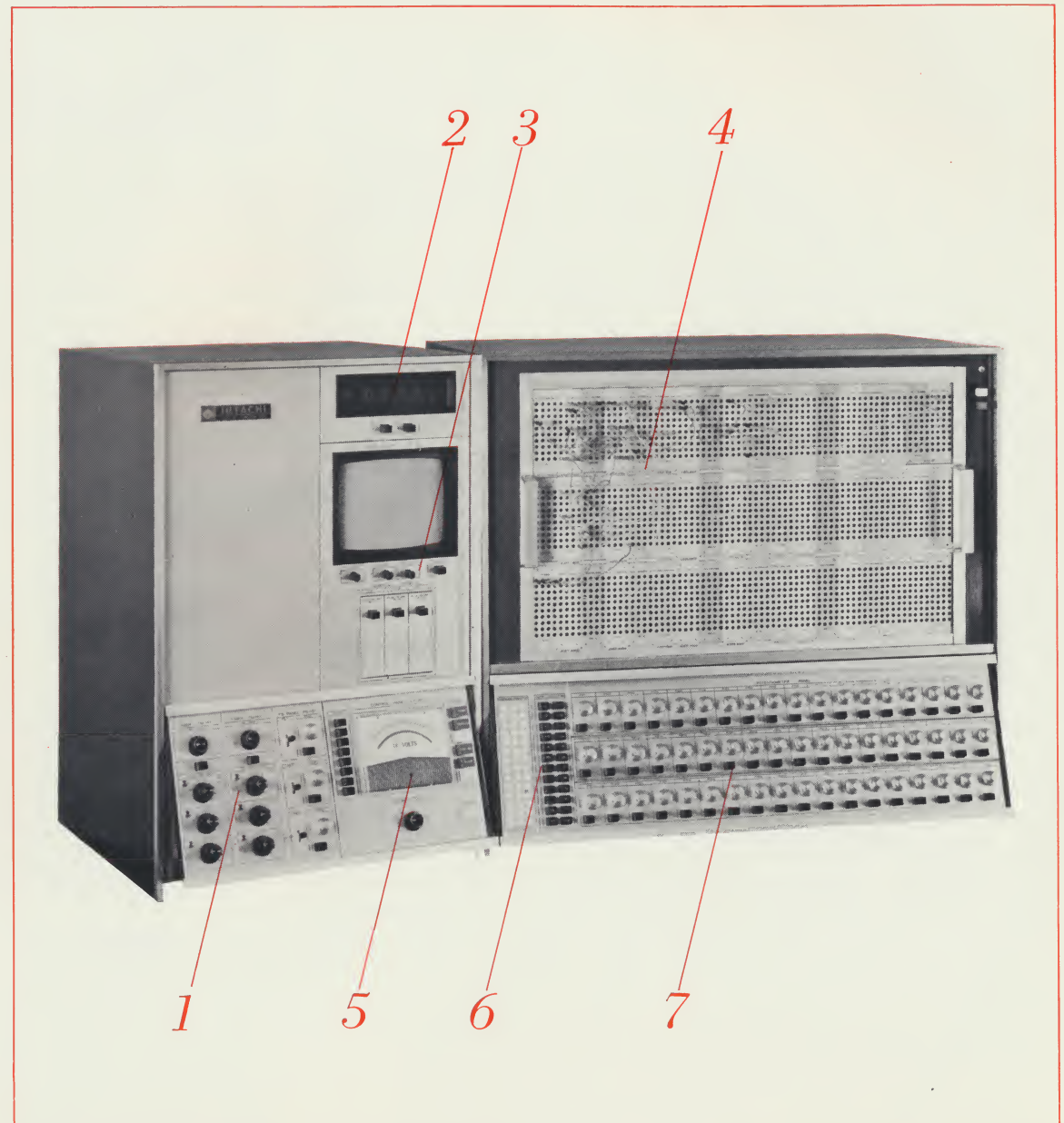
The problem solution is displayed on the oscilloscope screen or DVM located in the control module. Provisions are also made for recording the solution on an external device such as an X-Y recorder or a strip chart recorder.

THE HITACHI 505 IS AN ITERATIVE COMPUTER READILY CONVERTED TO HYBRID OPERATION

The design philosophy behind the Hitachi 505 insures flexibility and operation proficiency with a minimum of programming ability.

In a typical iterative computation situation, the process of logical programming for control of the time sequential operation mode is easily implemented on the Hitachi 505. Several new types of units called Compiled Operation Modules have been developed specifically for this situation. These Compiled Operation Modules are essentially variable gains with analog memories (useful in boundary value problems, optimum value problems and automatic parameter changes) and may be set up through simple patch board connections.

For iterative and logical computations, a digital logic operation unit may be added. This unit includes digital logic components such as flip-flops, logic gates, and ring counters. It may be used in conjunction with the analog computing components, permitting operations to be accomplished involving complicated iterative and integrated hybrid computations. This unit and the digital mode control simplifies the requirements involved when connecting a digital computer to the Hitachi 505 for hybrid computations.



FEATURES

1 A timer unit is located on the control panel. Each contains a time base generator and three preset counters permitting speed control for multi-time base operation. The time base generator provides independent time scale changes of 1:10, 1:100 and 1:1,000. The preset counter units permit the selection of time constants of 1, 0.1, 0.01 and 0.001 for changing the ratio between real time operation and high speed repetitive operation.

2 A four digit plus sign DVM readout displays problem solution from 000.00 to 199.99 volts (4 digits with overflow) to an accuracy of $0.01\% \pm 1$ bit.

3 A three-channel 9" oscilloscope furnishes a continuous display of three problem variables plotted vs. a fourth problem variable or time.

4 All amplifiers and computational networks, with the exception of the function set up parts of the function generators, are located directly behind the connector pins of each module. This improves the frequency response for high speed operation.

5 A voltmeter with a full scale range of ± 0.1 to ± 300 volts may be used for amplifier and input trunk monitoring, and for the balancing of DC amplifiers.

6 An amplifier output may be selected for readout on the voltmeter or DVM by means of pushbuttons arranged in columns of units and tens and corresponding to the patch panel numbering system. An Overload Indicator emits an audible signal and visual identification of any amplifier in an overloaded condition.

7 Ten-turn calibrated potentiometers are easily selected by a pushbutton located next to the knob. Pressing this button causes the pot setting to be displayed on the DVM and a corresponding indication lamp to light.

APPLICATIONS OF THE HITACHI 505

Automatic Parameter Changing

Variations in the solutions, corresponding to perturbations of the problem parameters, may be investigated automatically. This feature is useful for discovering the general nature of solution and parameter interactions.

Boundary Value Problems

As the Hitachi 505 is a multi-time scale computer, a portion of the machine may be operated in high speed repetitive mode while the remainder operates in real time. This feature is useful for the solution of two point boundary value problems.

System Optimizations

Optimization by a parameter surface search may be accomplished with the Compiled Operations Module.

Hybrid Computation

Analysis of control systems which include manual operation, and analysis of sampled data systems, etc., may be performed using hybrid computation techniques. The computer construction enables easy conversion to a true hybrid system with the addition of a digital computer.

SPECIFICATIONS

General Description

The Hitachi 505 console is a modular aluminum cabinet, prewired to accept the following equipment:

40 DC Amplifiers, 54 Potentiometers, 19 other modules (non-linear modules and Integrator Networks), 1 Two-variable Function Generator, 10 Free diodes, 80 Trunk Lines, 1 Power Supply, 1 Digital Voltmeter, 1 Oscilloscope, 1 Timer Unit, 1 Logic Control Panel, 1 Output Selector, and 1 Overload Indicator.

All amplifiers and computing networks, with the exception of the function set up parts of the function generators, are located in the patch bay area. The computing networks are located immediately behind the connecting pin of each module thereby reducing high frequency loss. Fifty-four modules are contained in this unit and a flexibility of network position is possible with the exception of the amplifiers and the potentiometers. The connection modules are color coded and the layout of connecting holes affords the maximum use of bottle plugs and short patch cords to reduce the pre-patch panel clutter to a minimum.

Power:	115/230 volts, 50-60 cycle at 400 watts maximum
Dimensions:	58½" × 32¼" × 21"
Weight:	440 lbs.

Control Module

Mode Control

Reset, Hold, Compute, Pot-Set, Slave, Rep-Op, and All Reset (resets all initial conditions regardless of patching).

Timer Unit

System control for the Iterative High Speed Operation.

3 timers	3 Two Decade Counters for controlling Reset, Compute, and Hold times.
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Voltmeter

Full scale ranges from ± 0.1 volts to ± 300 volts.

Digital Voltmeter

Voltage Range	000.00 to ± 199.99 volts (4 digit with overflow)
Range	Fixed
Input Impedance	50M ohms for voltage measurement
Balancing Time	Aproximately 0.8 seconds
Accuracy	0.01% ± 1 bit

Oscilloscope

Display	9" (T.V. Beam Scanning system using intensity modulation)
Y inputs	3 channels, 200 V, 100 V, 50 V and 20 V, Full Scale
X inputs	200 V, 100 V, 50 V and 20 V, F.S. and internal time base 2s, 1s, 500 ms, 200 ms, 100 ms, 50 ms, 20 ms, 10 ms and 5 ms, Full Scale
Scales	Electronically Generated 22 Line Grid

COMPUTATION COMPONENTS

Dual DC Amplifiers

Output	±100 volts 20 ma
Drift	±50 μ V/8 hours at constant Temp. at SJ.
Drift with Temperature	200 μ V/10°C, 0 to 45°C
Gain	10 ⁷ minimum
Input Current	10 ⁻¹⁰ a
Integrator Drift	100 μ V per sec., maximum
Noise (p-p)	5 mV maximum p-p
Capacitive Load	0.1 μ F maximum
Frequency Respose (-3 db)	200 kcps (100 k ohm inverter)
Phase Shift	0.03° at 100 cps

Variable Function Generator-1

Input Voltage	0 to +100 volts or 0 to -100 volts
Output Voltage	0 to ±100 volts
Segments	10 fixed
Maximum slope	at least 5 V/V
Parallax Range	±100 volts
Noise	150 mV maximum (peak to peak)
Frequency Response	Compatible with associated amplifier
Input Impedance	Approximately 10 k ohms
	Breakpoints are smoothed and temperature compensated.

Variable Function Generator-2

Input Voltage	-100 to +100 volts
Output Voltage	0 to ±100 volts
Segments	5 for positive input 5 for negative input
Maximum Slope	At least 5 V/V
	Breakpoints are smoothed and temperature compensated.

LOG Function Generator

Input Voltage (circuit 1)	0 to -100 volts
(circuit 2)	0 to +100 volts
Output Voltage (circuit 1)	0 to +100 volts
(circuit 2)	0 to -100 volts
Segment (contains 4 circuits)	9 per Generator
Accuracy	±0.5% FS maximum at DC
Frequency Response	Compatible with associated amplifier

Dual X² Function Generator

Segments	10 per Generator
Accuracy	±0.2% maximum at DC (±400 mV)
Frequency Respose	Compatible with associated amplifier
	Breakpoints are smoothed and temperature compensated.

Trigonometric Function Generator

Input Voltage	±100 volts
Output Voltage	±100 volts
Function Form (contains 2 circuits)	sin ($\pi x/100$), sin ($\pi x/200$) cos ($\pi x/100$), cos ($\pi x/200$)
Accuracy	±0.5% FS maximum at DC
Frequency Response	Compatible with associated amplifier
Function will be changed	by bottle plug

Dual Integrator Networks

Integrating capacitors	1 μ F, 0.1 μ F, 0.01 μ F, 0.001 μ F
Value	0.01% of maximum value (1 μ F)
Accuracy	Polyethylene (1 μ F)
Dielectric	±2×10 ⁻⁴ /°C (1 μ F)
Temp. Coeff.	100 K ohms 0.01%
Resistors for setting IC	by bottle plug
Individual Mode Control	by bottle plug
Selection of Time-Constant	Reed Relays
Mode Control Switch	

Quad Comparator

Sensitivity	50 mV
Operating Time	10 mS maximum (relay output), 500 μ S (voltage output)
Output Relay	DPDT
Number of Inputs	2

Multiplier

Input/Output Voltage	±100 volts
Accuracy	±0.1% at DC (±100 mV)
Frequency Response	Compatible with associated amplifier

Free Diode

Number of Diodes	Ten
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Potentiometer

Calibrated Dial with lock, individually fused.	
Turns	Ten
Resistance	30 k ohms
Linearity	.25%
Resolution	0.01%

Output Selector

The component outputs may be selected by pushbutton at an Output Selector Panel for readout on the voltmeter, or DVM, at the Operator's choice. The pushbuttons are arranged in columns of "units" and "tens" so that actuation of one button in each column will accomplish a selection of amplifier output.

Potentiometers may be connected to the voltage measuring system for adjustment by means of the pushbutton located under each potentiometer knob.

Overload Indicator

A visual and audible overload indicator is located on the Overload Indicator Panel, and will immediately identify any amplifier in overload condition. The audible alarm is provided with an adjustable volume.



Head Office: 4, 1-chome, Marunouchi, Chiyoda-ku,
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Tel. Tokyo (212) 1111 (80 lines)
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Codes: All Codes Used

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REPRESETED BY:

HITACHI 505 ANALOG COMPUTER - PRICE LIST

April 1966

MODEL	505-10		505-20		505-30		505-40		505-80	
Component Unit Price	Qty.	Price	Qty.	Price	Qty.	Price	Qty.	Price	Qty.	Price
DA-151 333.00	5	1,665.00	10	3,330.00	15	4,995.00	20	6,660.00	40	13,320.00
IN-151 199.00	2	398.00	4	796.00	6	1,194.00	8	1,592.00	16	3,184.00
PT-251 491.00	1	491.00	1	491.00	2	982.00	3	1,473.00	6	2,946.00
PT-151 45.00	3	135.00	3	135.00	6	270.00	9	405.00	18	810.00
EM-151 486.00					3	1,458.00	5	2,430.00	10	4,860.00
FG-151 35.00					1	35.00	2	70.00	4	140.00
FG-051A 183.00					1	183.00	2	366.00	4	732.00
FG-051B 183.00					1	183.00	2	366.00	4	732.00
FG-152 41.00					1	41.00	1	41.00	2	82.00
FG-052 183.00					2	366.00	2	366.00	4	732.00
FG-154A 568.00							1	568.00	1	568.00
FG-155A 459.00							1	459.00	1	459.00
CP-151 178.00					1	178.00	1	178.00	2	356.00
FD-151 193.00	1	193.00	1	193.00	1	193.00	1	193.00	2	386.00
TR-151 45.00					1	45.00	1	45.00	2	90.00
OC-151 96.00	1	96.00	1	96.00	1	96.00	1	96.00	1	96.00
FS-151 45.00	1	45.00	1	45.00	1	45.00	1	45.00	1	45.00
TW-051 94.00					1	94.00	1	94.00	2	188.00
OL-251 110.00	1	110.00	1	110.00	1	110.00	1	110.00	2	220.00
SL-251 110.00	1	110.00	1	110.00	1	110.00	1	110.00	2	220.00
CT-251 438.00	1	438.00	1	438.00	1	438.00	1	438.00	1	438.00
PS-051 788.00	1	788.00	1	788.00	1	788.00	1	788.00	2	1,576.00
CS-505A 1,460.00	1	1,460.00	1	1,460.00	1	1,460.00	1	1,460.00	2	2,920.00
TM-253 130.00	1	130.00	1	130.00	1	130.00	1	130.00	1	130.00
CS-505B 438.00	1	438.00	1	438.00	1	438.00	1	438.00	1	438.00
PP-505 203.00	1	203.00	1	203.00	1	203.00	1	203.00	2	406.00
PK-505 158.00	1	158.00	2	316.00	2	316.00	3	474.00	5	790.00
MU-051 47.00	1	47.00	1	47.00	1	47.00	1	47.00	1	47.00
FU-051 53.00	1	53.00	1	53.00	1	53.00	1	53.00	1	53.00
Handle 9.50	1	9.50	1	9.50	1	9.50	1	9.50	1	9.50
Cable 70.00									1	70.00
DVM 1,750.00			1	1,750.00	1	1,750.00	1	1,750.00	1	1,750.00
Total Price	\$ 6,967.00		\$10, 938.00		\$16, 210.00		\$21, 457.00		\$38, 793.00	

OPTIONAL ITEMS

FG-153	\$ 502.00
FG-256 C	\$ 1,460.00
FG-256 S	\$ 520.00
FG-157	\$ 82.00
FG-057	\$ 432.00
TD-151	\$ 187.00
AO-151	\$ 292.00
MC-151	\$ 41.00
TM-251	\$ 409.00
CT-252	\$ 210.00
CU-151	\$ 490.00
LG-151	\$ 210.00
FF-151	\$ 218.00
MM-151	\$ 111.00
RC-151	\$ 397.00
TR-153	\$ 210.00
PS-052	\$ 234.00
UM-251	\$ 292.00
OS-251	\$ 1,168.00
PC-001	\$ 1.20
PN-001	\$.60
AB-505	\$ 175.00
TOOLS	\$ 17.50

TERMS AND CONDITIONS

ORDERING EQUIPMENT

Please specify model number and model name

Place your order directly with our engineering representative in your area or with us.

Make your order out to WEST ELEVEN INC. in care of your local representative.

We acknowledge all orders. To facilitate acknowledgement on your own forms, please send them to us so that we can complete and return promptly.

SHIPMENTS

All shipments to destinations in the United States and Canada are made directly from our office in Los Angeles.

Billing is F.O.B. Los Angeles.

Shipments up to 20 lbs. shall be made by parcel post; over 20 lbs. will be shipped by express or truck. If requested we will ship via air express; air freight; air parcel post. All freight charges are prepaid and billed on the invoice unless the customer requests otherwise.

INVOICING

All invoices are normally made one day after shipment has been made. Terms are net 30 days.

WARRANTY

ONE YEAR WARRANTY: All Hitachi products are warranted against defects in materials and workmanship for a period of one year after date of shipment. Hitachi's obligation is limited to replacing, repairing, or adjusting products (except tubes) which are proved to be defective during the warranty period. Hitachi is not liable for consequential damages.

REPAIRS

If you wish to return equipment for repairs, please contact your local representative or West Eleven Inc. directly. All equipment unless you are instructed otherwise should be returned to West Eleven Inc., 11836 San Vicente Blvd., Los Angeles, California 90049, Attention: Engineering Service. Enclose a copy of your letter giving model number, model name, serial number, date received, purchase order number, and your exact return address. Send original letter to Engineering Service West Eleven Inc.

PRICE CHANGES

All published prices are subject to change without notification.

STATE AND LOCAL TAXES

All prices shown on West Eleven, Inc. price lists are given exclusive of all state and local taxes. If requested, state and local taxes will be shown on invoice.

MINIMUM ORDER

The minimum order is \$15.00